Hot bonded repair of aircraft structures

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Abstract

Ever since Boeing 707 passenger jet flew in 1950 with 2% of composites in its airframe, the use of composite structures is steadily increasing in military, civil and unmanned aircraft. Extensive use of composites structures, amounting to 45% of airframe weight in LCA and 50% in Boeing's dreamliner-787 are testimonies to this. While composites brought in several advantages, such as weight and cost reduction, fuel saving and improvised design solutions, they also posed new challenges in terms of maintenance and repair related issues. Unlike metallic structures, composites need special equipment for repair. Once the repair schemes/techniques are properly established, composites became the most preferred choice even for the repair of metallic structures.

Repair techniques play an important role in increasing the useful life of aircraft structures. They increase the confidence level of the user and promote the usage of composites. Several structural repair techniques are being evolved to enhance the aircraft service life. Among these repair techniques, hot bonding is widely acclaimed for its ability to restore strength to reasonable levels, amenability for in-situ or field repair and suitability for both metallic and composite structures.

This talk provides an insight into the nuances of hot bonded repair. It describes the practical problems associated with the in-situ repair of aircraft structures, such as the temperature gradient, quality control, flush repair of structures with one side access etc. The issue of temperature gradient during polymer cure that occurs due to non-uniform thickness, partial heating, variation in constituent materials etc., is explained. As a solution to the temperature gradient problem, the **Multi-zone hot bonder**, developed by the author is presented in detail. The additional benefits of the multi-zone hot bonder, which include curing a travel coupon (for destructive testing) along with the repair and performing simultaneous repair at multiple locations are highlighted. A special case of flush repair of structures constrained by one side access, using Shape Memory Alloys is also presented.